Simple spatial distribution models for vector density in a field

Bloodsucking creatures from dusk to dawn

Kirkeby, Carsten; Bødker, Rene; Stockmarr, Anders; Lind, Peter; Græsbøll, Kaare

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Bloodsucking creatures from dusk to dawn

Carsten Kirkeby

René Bødker
Anders Stockmarr
Peter Lind
Kaare Græsbøll

DTU Vet
National Veterinary Institute

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Introduction

Bluetongue virus in Northern Europe

- Infects ruminants
- Vector-borne
- Females of:

  Culicoides obsoletus group

  Culicoides pulicaris group

Objectives

- Model vector dispersal → spread of virus

- First step: Where are the vectors?

  → (Spatial) factors for vector density?

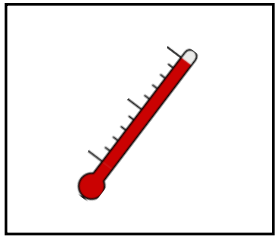
- Spatial prediction model

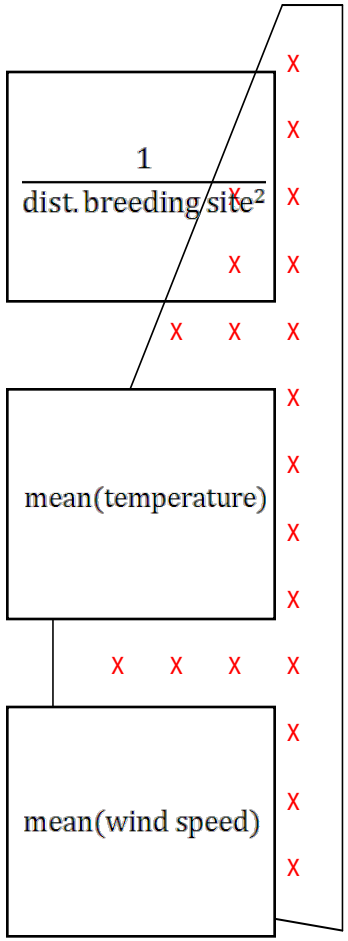
- Linear Mixed Model

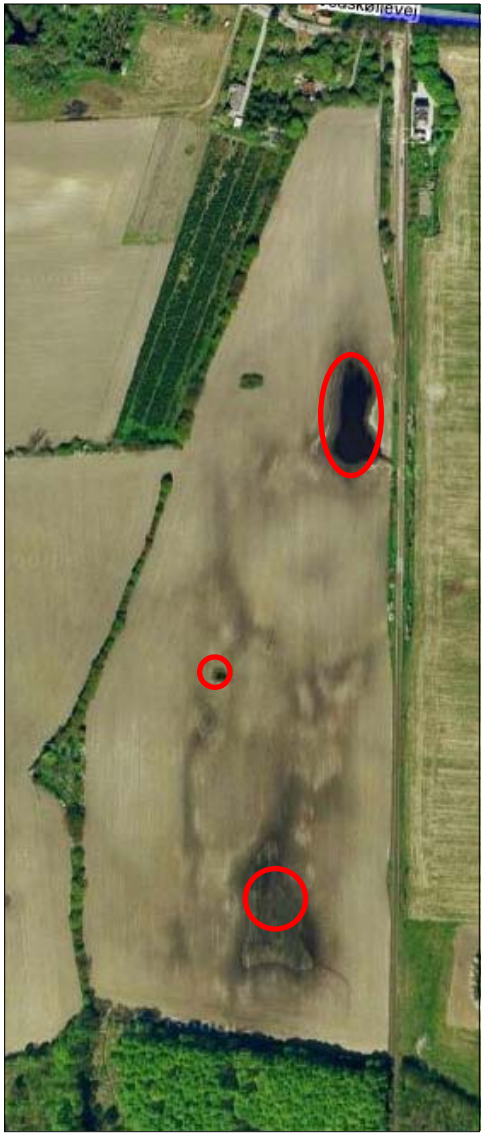
- Density measure: Light trap

Study design

- 50 light traps – 50 m grid
- Dist. to Breeding sites
- Temperature
- Wind speed







Study design

- Smell of host animals

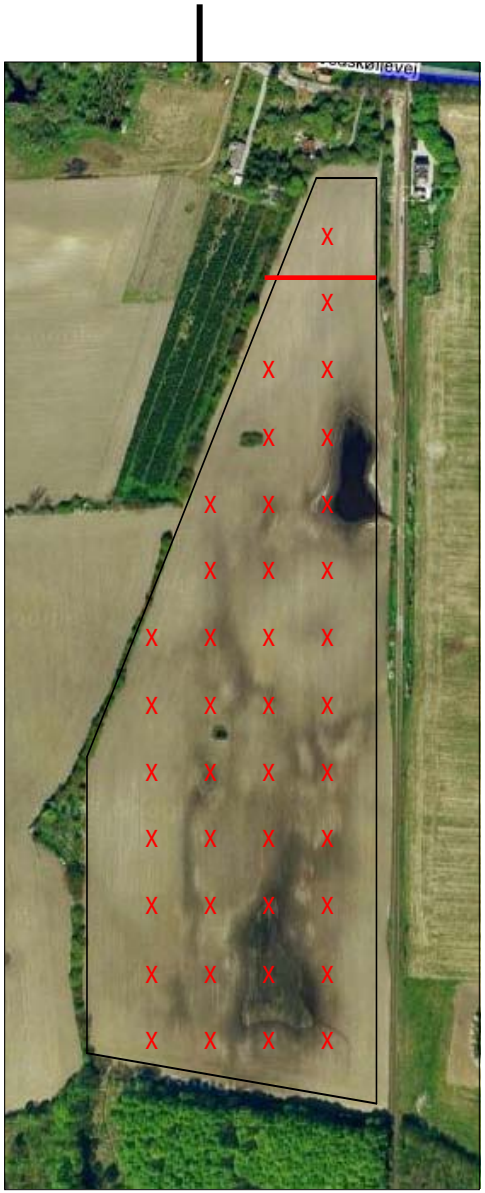
$$\text{wind speed} * \text{wind effect} * \frac{1}{1 + \text{dist.sheep}^2}$$

- Windbreaks

$$\text{wind effect} * \frac{1}{1 + \text{dist.windbreak}}$$

- Interactions:

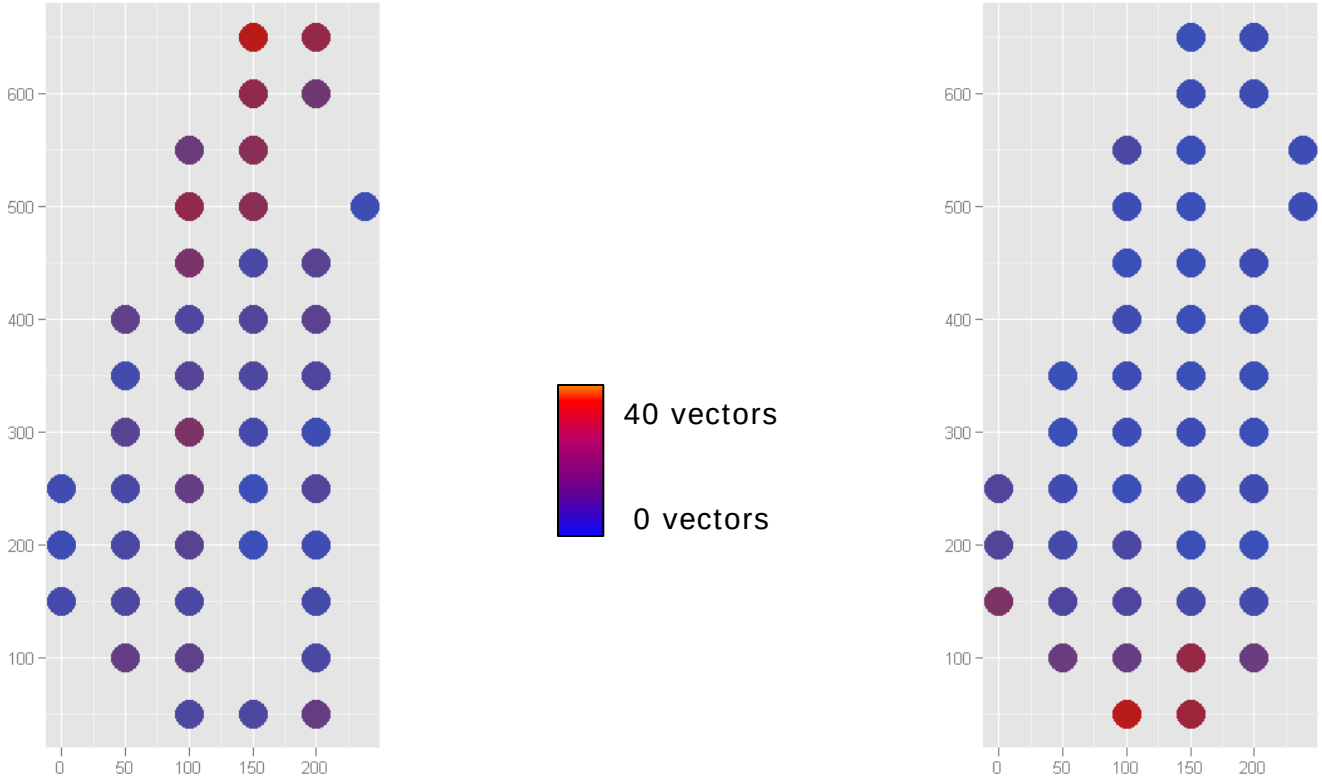
  Host animals * Windbreaks
  Wind speed * Windbreaks,
  Temperature^2



Dataset

Analysis of 8 days: 5180 female vectors

Day	A	B	C	D	E	F	G	H	Total
C. obsoletus	316	259	612	2	93	95	29	253	1659
C. pulicaris	1524	335	952	4	190	223	33	260	3521



Dataset

- Temperature: 12 – 20°c
- Wind speeds: 0.2 – 3.3 m/s

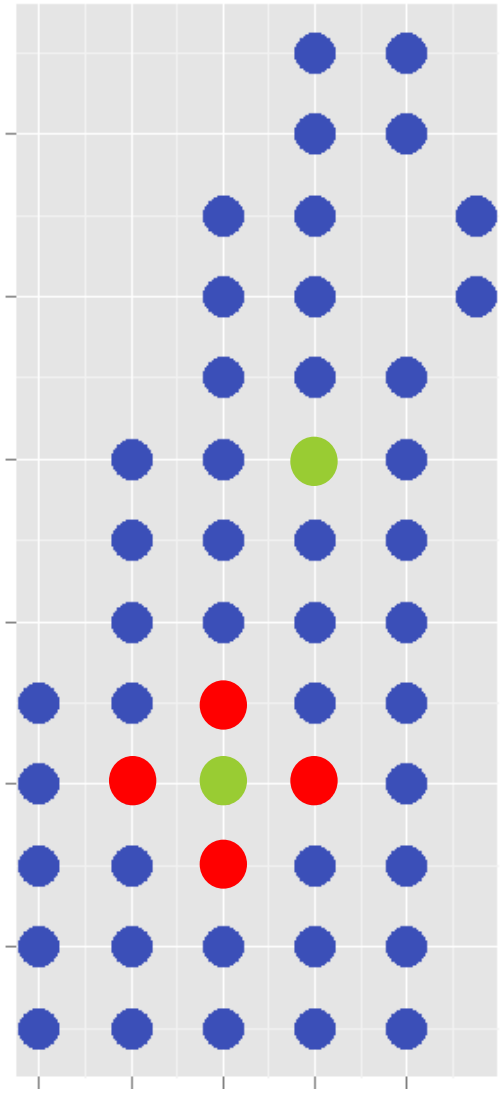
Procedures

- Normalize data
- Random effect → Mixed Effects Model
- Observations not independent…

Data analysis

Spatial correlation

- *All information on the surroundings for a trap is contained within the neighbors*
- X $\perp\!\!\!\perp$ Y | Neighbors
- Corr(X, Neighbor) = ρ



Final model

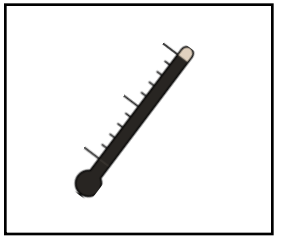
- *C. pulicaris estimates*

Wind speed: -0.56 *N.S.*
Windbreaks: 2.34
Wind speed : Windbreaks : -1.19

(adjusted for spatial correlation) *N.S.*

- *Spatial correlation coefficient*, ρ = *0.26* ***

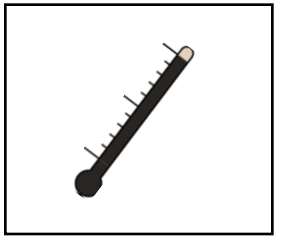
N.S.


Final model

- *C. obsoletus estimates*

Wind speed: -0.59 *N.S.*



(adjusted for spatial correlation)

N.S.

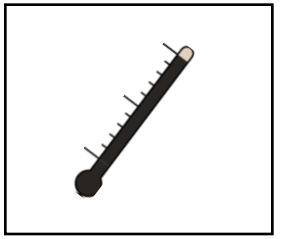
- *Spatial correlation coefficient*, ρ = *0.33* ***

N.S.

N.S

Conclusions

- Temperature not significant
- Breeding sites not significant
- Host animals not significant
- Windbreaks significant for *C. pulicaris*
- Wind speed significant



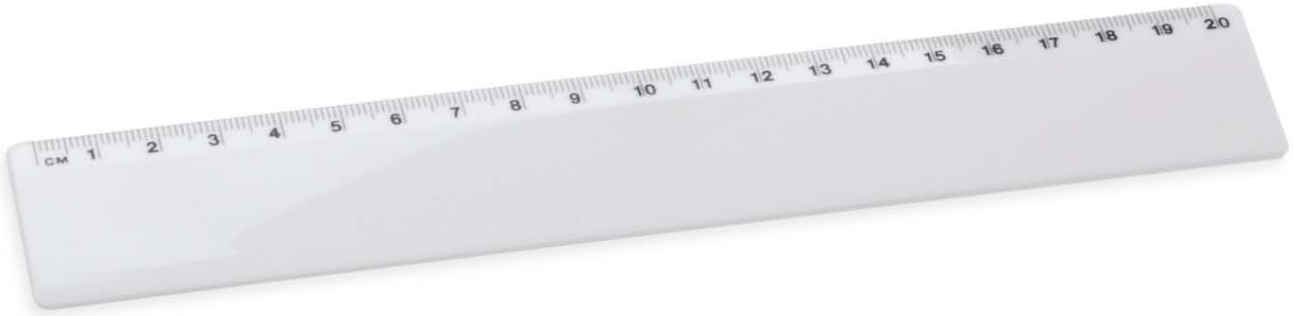
What´s next?

- More covariates

  Precipitation?

- More days

- Broader scale



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Thank you for your attention
Comments are welcome

ckir@vet.dtu.dk

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